METHOD AND APPARATUS FOR LIPOSOME PRODUCTION

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates to a formulation for the delivery of a variety of beneficial and/or therapeutic compounds by encapsulation within liposomes, and a machine of unique design for the controlled production of same. Specifically the invention relates to a precisely controlled metering system for the mixing of the two or more components of the liposomal preparations so that the various factors affecting the consistency, reproducibility and efficacy of the product may be monitored and controlled. The present invention also relates to a method and apparatus for the production of liposomal suspensions, emulsions, ointments and creams.

Background

Liposomes are lipid vesicles made of membrane-like lipid bilayers separated by aqueous layers. Liposomes have been widely used to encapsulate biologically active agents for use as drug carriers since water- or lipid-soluble substances may be entrapped within the aqueous layers or within the bilayers themselves. There are numerous variables that can be adjusted to optimize this drug delivery system. These include, the number of lipid layers, size, surface charge, lipid composition and the methods of preparation.

Liposomes have been utilized in numerous pharmaceutical applications, including injectable, inhalation, oral and topical formulations, and provide advantages such as controlled or sustained release, enhanced drug delivery, and reduced systemic side effects as a result of delivery localization.

Materials and procedures for forming liposomes are well-known to those skilled in the art and will only be briefly described herein. Upon dispersion in an appropriate medium, a wide variety of phospholipids swell, hydrate and form multilamellar concentric bilayer vesicles with layers of aqueous media separating the lipid bilayers. These systems are referred to as multilamellar liposomes or multilamellar lipid vesicles ("MLVs") and have diameters within the range of 10 nm to 100μm. These MLVs were first described by Bangham, et al., *J. Mol. Biol.* 13:238-252 (1965). In general, lipids or lipophilic substances are dissolved in an organic solvent. When the solvent is removed, such as under vacuum by rotary evaporation, the lipid residue forms a film on the wall of the container. An aqueous

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